(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号

特開平6－262026

(43)公開日　平成６年(1994)９月20日

(51)Int.Cl.[5]	識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｂ０１Ｄ　53/22		9153－4D		
63/10		8014－4D		

審査請求　未請求　請求項の数２　ＯＬ　（全　８　頁）

(21)出願番号　特願平5－50327

(22)出願日　平成５年(1993)３月11日

(71)出願人　000005821
松下電器産業株式会社
大阪府門真市大字門真1006番地

(72)発明者　木村　雅典
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(72)発明者　沢田　太助
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(72)発明者　畠中　茂樹
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(74)代理人　弁理士　小鍜治　明　（外２名）

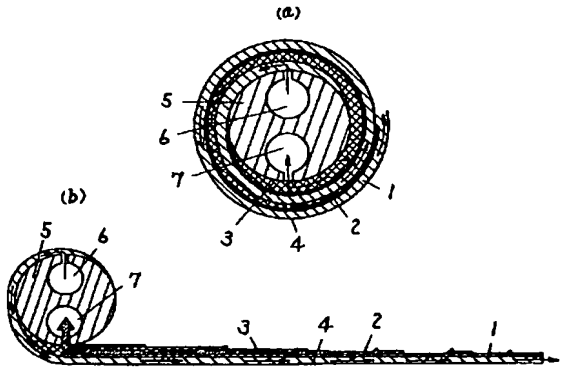
最終頁に続く

(54)【発明の名称】　気体分離膜モジュール

(57)【要約】

【目的】　透過気体流路中での圧力損失による性能低下が無く、しかも体積効率の高い気体分離膜モジュールを提供する。

【構成】　透過気体流路材３を一部が気体非透過膜４で構成された平膜状の気体分離膜２で挟み、原料気体流路材１と共に、給気管６と排気管７とが一体となった給排気管５の周りにスパイラル状に巻回し、巻始めの一端は原料気体流路材１と給気管６が連通し、かつ、透過気体流路材３と排気管７が連通するように給排気管５に気体分離膜２を接着し、巻終わりの一端は透過気体流路３を気密に閉じるように気体分離膜２を袋状とし、巻回方向の両側端部は原料気体流路と透過気体流路を気密に隔てるように封止し、巻終わりから巻始めに至る過程で、透過気体流路材３を順次厚くした構成を有している。



1

【特許請求の範囲】

【請求項１】　透過気体流路材を平膜状の気体分離膜、あるいは一部が気体非透過膜で構成された平膜状の気体分離膜で挟み、前記透過気体流路材を挟んだ気体分離膜と原料気体流路材とを重ねて一組とし、この少なくとも一組を、原料空気を供給する給気管と透過気体を排気する排気管とが一体となった給排気管の周りにスパイラル状に巻回し、巻始めの一端は原料気体流路材と給排気管の給気管が連通し、かつ、透過気体流路材と給排気管の排気管が連通するように給排気管に前記気体分離膜を接着し、巻終わりの一端は透過気体流路を気密に閉じるように前記気体分離膜を袋状とし、巻回方向の両側端部は原料気体流路と透過気体流路を気密に隔てるように封止した気体分離膜モジュールであって、巻終わりから巻始めに至る過程で、前記透過気体流路材を順次厚くした気体分離膜モジュール。

【請求項２】　透過気体流路材を平膜状の気体分離膜、あるいは一部が気体非透過膜で構成された平膜状の気体分離膜で挟み、前記気体分離膜の両側端部を封止し、前記透過気体流路材を挟んだ気体分離膜と原料気体流路材とを重ねて一組とし、この少なくとも一組を、排気管の周りにスパイラル状に巻回し、巻始めの一端は透過気体を排気する排気管と透過気体流路材が連通するように排気管に前記気体分離膜を接着し、巻終わりの一端は透過気体流路を気密に閉じるように前記気体分離膜を袋状とした気体分離膜モジュールであって、巻終わりから巻始めに至る過程で、前記透過気体流路材を順次厚くした気体分離膜モジュール。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は平膜の気体分離複合膜を巻回してなるスパイラル型気体分離膜モジュールに関するものである。

【０００２】

【従来の技術】一般に平膜を巻回してなるスパイラル型の気体分離膜モジュールは、透過気体流路を形成する透過気体流路材を平膜状の気体分離膜で挟んで、穴を有する中空管の穴に透過気体流路が連通するように中空管に気体分離膜を接着し、原料気体流路を形成する原料気体流路材と共に中空管の周りに巻回して構成される。また、発明者等は特願平４－２４９７１１号において、独立した複数の穴を有する中空管の穴に、透過気体流路材及び原料気体流路材がそれぞれ連通するように中空管に気体分離膜を接着し、中空管の周りに巻回して構成される気体分離膜モジュールを提案した。

【０００３】上記従来の気体分離膜モジュールの気体の分離、濃縮について原料気体を空気とし窒素を分離、濃縮する場合について図を用いて説明する。

【０００４】図５、図６は従来のスパイラル型の気体分離膜モジュールの例で、図５（ａ），（ｂ）はそれぞれ

2

従来例１の気体分離膜モジュールの断面図、気体分離膜モジュールを展開した断面斜視図、図６（ａ），（ｂ），（ｃ）はそれぞれ従来例２の気体分離膜モジュールの断面図、気体分離膜モジュールを展開した断面斜視図、気体の流れを示す気体分離膜モジュールを展開した断面図である。

【０００５】図５において、２２は気体分離膜を多孔質支持体上に形成した平膜状の気体分離複合膜であり、透過気体流路材２３を挟むように折り返してあり、折り返し部分が巻き終わりになっている。また気体分離複合膜２２の巻回方向（中空管に対して垂直方向）の両側端部は封止材２５で封止してあり、巻始めの一端は透過気体流路材２３と中空管２６が連通するように気体分離複合膜２２が中空管２６に接着されている。原料気体流路は解放されている。

【０００６】上記構成において、原料気体流路材２１で構成された原料気体流路に原料空気を矢印（実線）の方向に供給すると、原料空気は酸素を優先的に透過する気体分離複合膜２２の表面上を流れていく。その時酸素は優先的に気体分離複合膜２２を透過し透過気体流路材２３で構成された透過気体流路を矢印（破線）の方向に流れて行き、中空管２６より排出される。そのため気体分離複合膜上を通過し、気体分離膜モジュールから出て来た空気は窒素が濃縮されることとなる。

【０００７】また、図６は、透過気体流路材２３を平膜状の気体分離複合膜２２と気体非透過膜２４で挟み、原料気体流路材２１と共に、独立した給気管２８と排気管２９を有する給排気管２７の周りに巻回したスパイラル型の気体分離膜モジュールで、給気管２８と原料気体流路材２１及び排気管２９と透過気体流路材２３がそれぞれ連通するように気体分離複合膜２２及び気体非透過膜２４を給排気管２７に接着させ、更に巻回方向の両側端部を原料気体流路と透過気体流路を気密に隔てるように封止してある。

【０００８】このスパイラル型気体分離膜モジュールの給気管２８から原料空気を供給すると、原料気体供給流路を矢印（実線）の方向に気体分離複合膜２２の表面上を流れ、従来例１の気体分離膜モジュールと同様に酸素の優先的な透過により、窒素を濃縮できる。この気体分離膜モジュールでは原料空気が巻回方向に流れることによって、原料空気が気体分離複合膜表面上を流れる距離を長くすることができ、濃縮効率の高い気体分離膜モジュールが得られる。

【０００９】

【発明が解決しようとする課題】しかしながら、いずれにしても上記従来の気体分離膜モジュールの透過気体流路材２３の厚さは、巻終わりから巻始めに至る過程において一定であるため、気体の流れる流路の断面積が一定となる。これに対し、透過気体流路材２３中を流れていく透過気体の流量は、図６（ｃ）に示すように気体分離

複合膜の巻き終わりから巻き始めに至る過程で、順次積算され増大していき、排気管２７と連通する部分では、気体分離膜２２全面で透過した量の透過気体が通過することになる。即ち、一定の厚さ（流路の断面積が一定）の透過気体流路材中では、流量の増大に比例し流動抵抗も増大し、透過気体流路材の厚さが充分でない場合には、流動抵抗が大きくなり圧力損失を生じて、気体分離膜を介して所定の圧力差が得られなくなり、充分な性能を確保できなくなる。

【００１０】また、透過気体流路中、透過気体流量が最も多くなる排気管と連通する部分において、圧力損失が充分に小さくなるように透過気体流路材の厚さを決定した場合、透過気体流路材の厚さが一定であるために排気管から巻終わり部分に至るにつれて必要以上に透過気体流路材が厚くなることになり、巻回した気体分離膜モジュールの外形が大きくなり、気体分離膜モジュールの性能に対する体積効率が低下することになる。

【００１１】一般的にスパイラル型の気体分離膜モジュールにおいては、原料気体を加圧供給する方式がとられているため、供給気体の体積は大気圧下の数分の１になる。これに対して透過気体は大気圧となるため、透過気体の流量は供給気体の数倍になり、透過気体流路材の厚さは原料気体流路材の数倍必要となる。従って気体分離膜モジュールにおける透過気体流路材の占める体積比率は高くなり、透過気体流路材を如何に薄くできるかが、体積効率の向上、即ち性能向上及び小型化の重要な課題となる。

【００１２】本発明は上記従来の課題を解決するもので、濃縮効率及び体積効率の優れた気体分離膜モジュールを提供することを目的とする。

【００１３】

【課題を解決するための手段】この目的を達成するために本発明の気体分離膜モジュールは、透過気体流路材を平膜状の気体分離膜、あるいは一部が気体非透過膜で構成された平膜状の気体分離膜で挟み、上記透過気体流路材を挟んだ気体分離膜と原料気体流路材とを重ねて一組とし、この少なくとも一組を、原料空気を供給する給気管と透過気体を排気する排気管とが一体となった給排気管の周りにスパイラル状に巻回し、巻始めの一端は原料気体流路材と給排気管の給気管が連通し、かつ透過気体流路材と給排気管の排気管が連通するように給排気管に上記気体分離膜を接着し、巻終わりの一端は透過気体流路を気密に閉じるように上記気体分離膜を袋状とし、巻回方向の両側端部は原料気体流路と透過気体流路を気密に隔てるように封止した気体分離膜モジュールであって、巻終わりから巻始めに至る過程で、上記透過気体流路材を順次厚くした構成を有している。

【００１４】また透過気体流路材を平膜状の気体分離膜、あるいは一部が気体非透過膜で構成された平膜状の気体分離膜で挟み、この気体分離膜の両側端部を封止し、上記透過気体流路材を挟んだ気体分離膜と原料気体流路材とを重ねて一組とし、この少なくとも一組を排気管の周りにスパイラル状に巻回し、巻始めの一端は透過気体を排気する排気管と透過気体流路材が連通するように排気管に上記気体分離膜を接着し、巻終わりの一端は透過気体流路を気密に閉じるように上記気体分離膜を袋状とした気体分離膜モジュールであって、巻終わりから巻始めに至る過程で、上記透過気体流路材を順次厚くした構成を有している。

【００１５】

【作用】この構成により、気体分離膜モジュールにおいて体積比率の高い透過気体流路材を削減でき、しかも巻終わりから巻き始めに至る過程において透過気体の流量が順次増大しても、それに伴い透過気体流路材が順次厚くなり流路が大きくなるため、圧力損失による性能低下の無い、体積効率の高い気体分離膜モジュールを実現できる。

【００１６】

【実施例】

（実施例１）以下本発明の一実施例について、図面を参照しながら説明する。図１（ａ）は本実施例の気体分離膜モジュールの断面図、図１（ｂ）、図２は気体分離膜モジュールを展開した断面図、図３は本実施例の使用例である。

【００１７】図１において、１は原料気体流路材で、厚さ０．４㎜の１５メッシュのポリエチレン成形ネットを１枚用いてある。２は気体分離複合膜で、多孔質支持体上にポリ４メチルペンテン１の気体分離膜を積層し、更にその上にポリジメチルシロキサンを積層した非対称構造で、分離膜側が原料気体流路材１と相対するように配されている。

【００１８】３は透過気体流路材で、厚さ０．４㎜の１５メッシュのポリエチレン成形ネットを巻終わりから１００㎝迄は１枚で、それ以降５０㎝ごとに１枚ずつ増やして積層し構成されている。４は気体非透過膜で厚さ１００μｍのポリエステルフィルムである。５は給排気管で給気管６と排気管７が、長さ方向に独立して平行に配されており、給気管６、排気管７にはそれぞれ外部と連通する穴があいている。

【００１９】上記の原料気体流路材１が給気管６に、透過気体流路材３が排気管７に連通するように、気体分離複合膜２及び気体非透過膜４を給排気管５に気密に接着し、原料気体流路材１から気体非透過膜４の材料を給排気管５の回りにスパイラル状に巻回した後、気体分離複合膜２の巻終わりの一端で気体分離複合膜２と気体非透過膜４を気密に接着し、他の二辺を図３のように封止材８によって原料気体流路と、透過気体流路を気密に隔てるように接着封止する。

【００２０】以上のように構成された気体分離膜モジュールは、透過気体流路材のみ一定の厚さにして同様に作

成した気体分離膜モジュールに比較して、透過気体流路材の使用量はほぼ半分となり、気体分離膜モジュールの外径は３０㎜小さくなった。

【００２１】また、図３に示すように、上記気体分離膜モジュールを圧力容器９内に収納し、給気管６から５９２Ｐａ（５kgf／㎠Ｇ）に加圧された空気４．２×１０$^{-4}$m^3／ｓ（２５ｌ／ｍｉｎ）を供給し、流量調節弁１０から得られる窒素濃縮空気流量を８．３×１０$^{-5}$ｍ^3／ｓ（５ｌ／ｍｉｎ）に調節したところ窒素濃度は９７．５％であった。

【００２２】以上のように本実施例によれば、透過気体流路材を気体非透過膜と平膜状の気体分離膜で挟み、透過気体流路材を挟んだ気体分離膜と原料気体流路材とを重ねて一組とし、この一組あるいは複数組を、原料空気を供給する給気管と透過気体を排気する排気管とが一体となった給排気管の周りにスパイラル状に巻回し、巻始めの一端は原料気体流路材と給排気管の給気管が連通し、かつ、透過気体流路材と給排気管の排気管が連通するように給排気管に気体非透過膜及び気体分離膜を接着し、巻終わりの一端は透過気体流路を気密に閉じるように非透過気体透過材と気体分離膜を袋状に接着し、巻回方向の両側端部は原料気体流路と透過気体流路を気密に隔てるように封止し、巻終わりから巻始めに至る過程で、透過気体流路材を順次厚くすることにより、体積効率の高い気体分離膜モジュールが得られる。

【００２３】尚、本実施例の気体分離膜モジュールの透過気体流路材３を構成しているネットの積層数、及び積層しているそれぞれのネットの長さは、ネットの単位体積当たりの空間の割合、気体分離膜の気体透過性能、気体分離性能、気体分離膜モジュールの回収率（給気空気量に対する窒素濃縮空気量の比率）等によって最適な値が決定されるため、本実施例の値に限定されるものではない。

【００２４】また本実施例の気体分離膜モジュールの透過気体流路材３は、ポリエチレンネットを積層して用いたが、これは例えばポリプロピレン、ポリ塩化ビニル等の樹脂を用いたネット、あるいはウレタン、ポリスチレン等を用いた発泡フォーム、あるいはポリエステル等を用いた不織布等、気体の流路を形成する成形樹脂品なら特に限定されるものではない。

【００２５】更に本実施例では一定の厚みのネットを積層した構成としたが、図２の３－１に示すように、ネットや上記の流路材をなめらかに厚みが変わるように一体的に成形した構成としても良く、この場合には体積効率が良くなり、ネットの段差による気体分離膜の変形も回避でき、巻取り工数も削減できる。

【００２６】（実施例２）以下本発明の第２の実施例について、図４を参照しながら説明する。

【００２７】１は原料気体流路材で実施例１と同様な構成であるが、巻回方向の長さは２分の１になっている。

２は気体分離複合膜で実施例１と同様な構成であるが、透過気体流路材３を挟むように折り返し、折り返し部分が巻終わりとなるようにし、両側端部を封止してある。また気体分離複合膜２の折り返し部分には気体非透過膜４が接着されており、気体非透過膜４は気体分離複合膜２の外周を覆っている。３は透過気体流路材でこれも実施例１と同様な構成であるが、巻終わりから５０㎝迄が１枚で、それ以降２５㎝ごとに１枚ずつ増やして積層した構成としている。

【００２８】上記の原料気体流路材１が給気管６に、透過気体流路材３が排気管７に連通するように、気体分離複合膜２を給排気管５に気密に接着し、原料気体流路材１から気体非透過膜４の材料を給排気管５の回りにスパイラル状に巻回する。この気体分離膜モジュールの外径は実施例１の気体分離膜モジュールに比べ、１０㎜小さくなった。

【００２９】以上のように構成された気体分離膜モジュールを図３に示すように圧力容器９内に収納し、給気管６から５９２Ｐａ（５kgf／㎠Ｇ）に加圧された空気４．２×１０$^{-4}$m^{3}3／ｓ（２５ｌ／ｍｉｎ）を供給し、流量調節弁１０から得られる窒素濃縮空気流量を８．３×１０$^{-5}$m^3／ｓ（５ｌ／ｍｉｎ）に調節したところ窒素濃度は９７．４％であった。

【００３０】以上のように本実施例によれば、一部が気体非透過膜で構成された平膜状の気体分離膜で透過気体流路材を挟み、この透過気体流路材を挟んだ気体分離膜と原料気体流路材とを重ねて一組とし、この一組あるいは複数組を、原料空気を供給する給気管と透過気体を排気する排気管とが一体となった給排気管の周りにスパイラル状に巻回し、巻始めの一端は原料気体流路材と給排気管の給気管が連通し、かつ、透過気体流路材と給排気管の排気管が連通するように給排気管に気体分離膜を接着し、気体分離膜の巻終わりの一端が気体分離膜の折り返し部分となるようにし、巻回方向の両側端部は原料気体流路と透過気体流路を気密に隔てるように封止し、巻終わりから巻始めに至る過程で、透過気体流路材を順次厚くすることにより、透過気体流路材を更に削減でき、体積効率をより向上できる。

【００３１】

【発明の効果】以上のように本発明によれば、透過気体流路材を平膜状の気体分離膜、あるいは一部が気体非透過膜で構成された平膜状の気体分離膜で挟み、この透過気体流路材を挟んだ気体分離膜と原料気体流路材とを重ねて一組とし、この一組あるいは複数組を、原料空気を供給する給気管と透過気体を排気する排気管とが一体となった給排気管の周りにスパイラル状に巻回し、巻始めの一端は原料気体流路材と給排気管の給気管が連通し、かつ、透過気体流路材と給排気管の排気管が連通するように給排気管に気体分離膜を接着し、巻終わりの一端は透過気体流路を気密に閉じるように気体分離膜を袋状と

し、巻回方向の両側端部は原料気体流路と透過気体流路を気密に隔てるように封止し、巻終わりから巻始めに至る過程で、前記透過気体流路材を順次厚くした構成、または平膜状の気体分離膜、あるいは一部が気体非透過膜で構成された平膜状の気体分離膜で透過気体流路材を挟み、気体分離膜の両側端部を封止し、透過気体流路材を挟んだ気体分離膜と原料気体流路材とを重ねて一組とし、この一組あるいは複数組を、排気管の周りにスパイラル状に巻回し、巻始めの一端は透過気体を排気する排気管と透過気体流路材が連通するように排気管に気体分離膜を接着し、巻終わりの一端は透過気体流路を気密に閉じるように気体分離膜を袋状とし、巻終わりから巻始めに至る過程で、透過気体流路材を順次厚くした構成とすることにより、巻終わりから巻き始めに至る過程において透過気体の流量が順次増大しても、それに伴い流路材が順次厚くなり流路が大きくなるため、圧力損失による性能低下の無い、しかも体積効率の高い気体分離膜モジュールを実現できる。

【図面の簡単な説明】

【図１】実施例１の気体分離膜モジュールの（ａ）断面＊図および（ｂ）展開断面図

【図２】実施例１の他の気体分離膜モジュールを展開した断面図

【図３】実施例１および２の気体分離膜モジュールの使用例を示す断面図

【図４】実施例２の気体分離膜モジュールの断面図

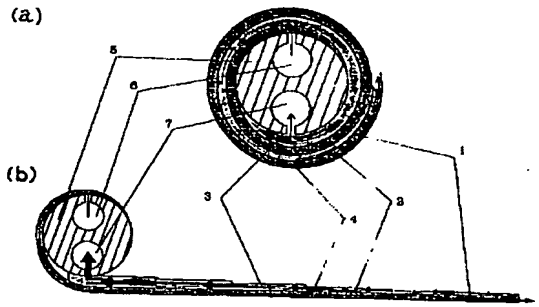
【図５】従来例１の気体分離膜モジュールの（ａ）断面図および（ｂ）一部展開斜視図

【図６】従来例２の気体分離膜モジュールの（ａ）断面図、（ｂ）一部展開斜視図および（ｃ）展開断面図

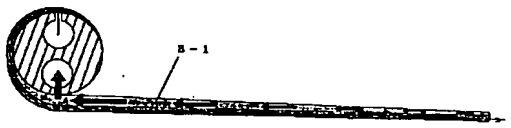
【符号の説明】

1　原料気体流路材
2　気体分離複合膜
3　透過気体流路材
4　気体非透過膜
5　給排気管
6　給気管
7　排気管
8　封止材

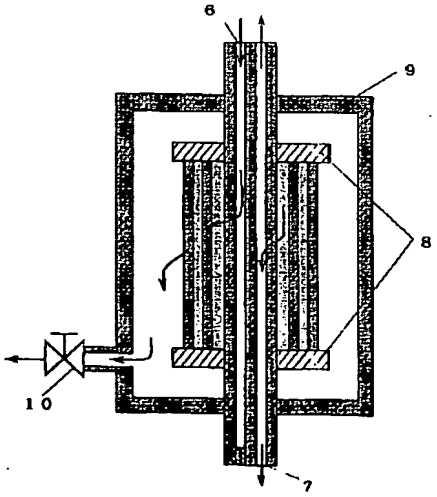
【図１】



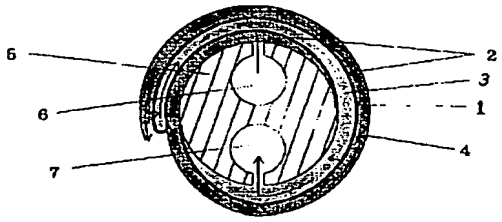
【図２】



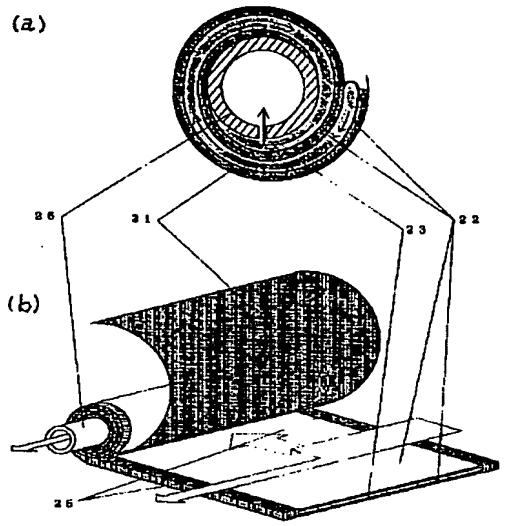
【図３】



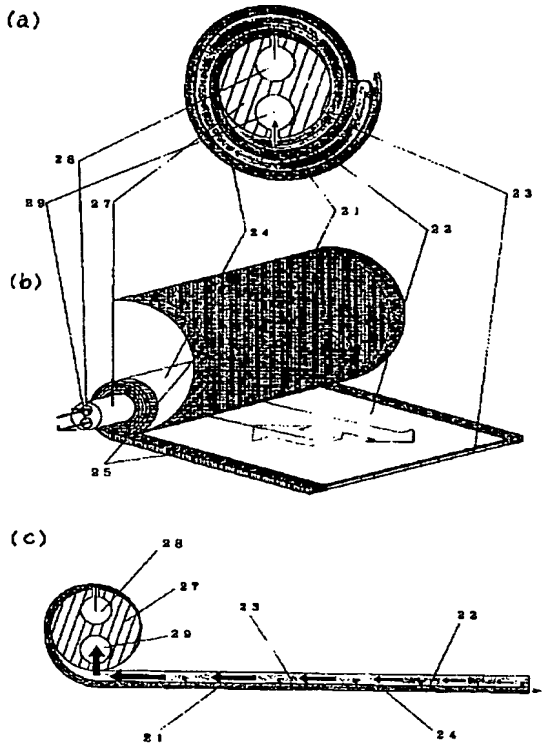
【図４】



【図５】

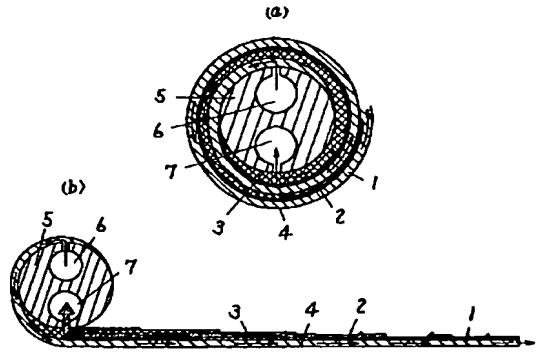


【図６】

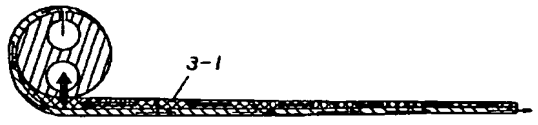


【手続補正書】
【提出日】平成６年２月７日
【手続補正１】
【補正対象書類名】図面
＊【補正対象項目名】全図
【補正方法】変更
＊【補正内容】

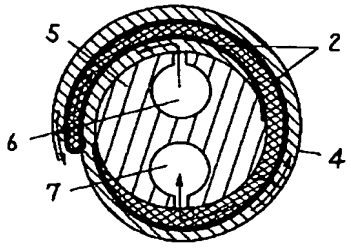
【図１】



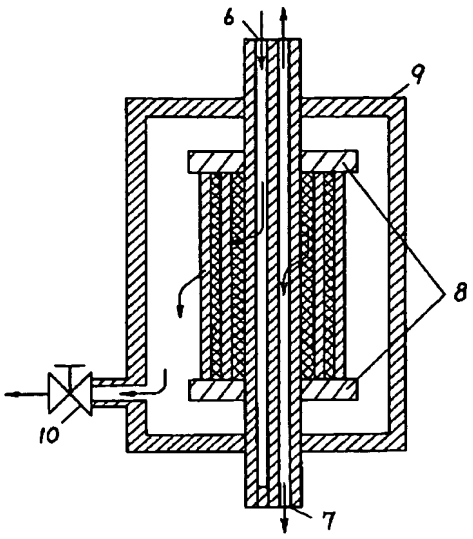
【図２】



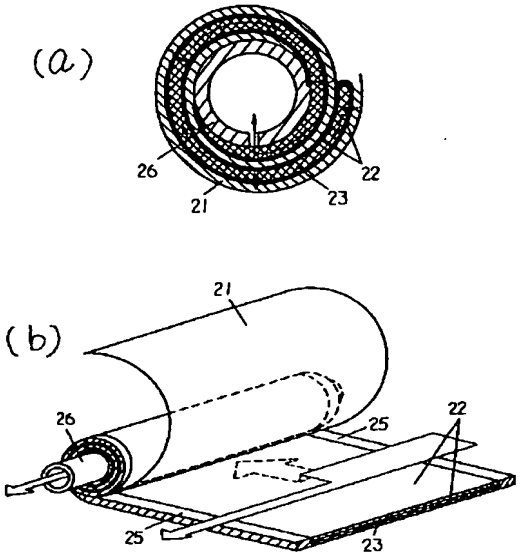
【図４】



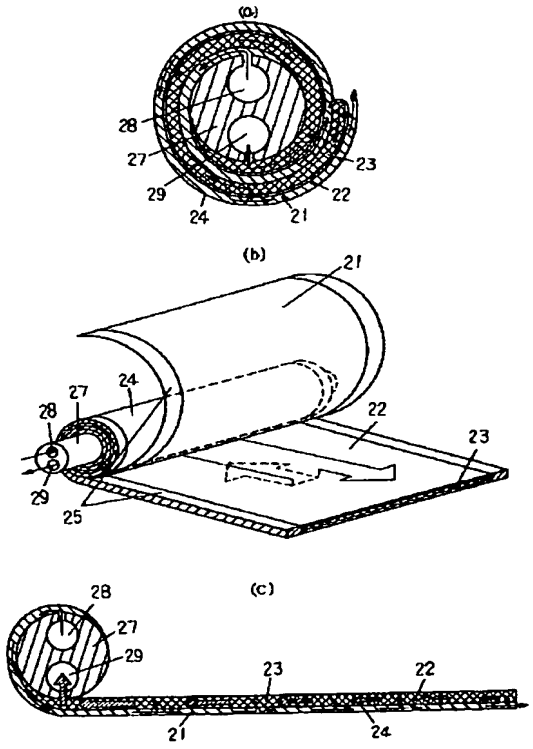
【図３】


6
9
8
10
7

【図５】


(a)
26
22
21
23
(b)
21
26
25
22
25
23

【図６】


(a)
28
27
23
29
22
24
21
(b)
21
24
27
28
22
23
29
25
(c)
28
27
29
23
22
21
24

フロントページの続き

(72)発明者　小林　貴樹
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(72)発明者　菅藤　雅哉
大阪府門真市大字門真1006番地　松下電器産業株式会社内

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 06-262026
(43)Date of publication of application : 20.09.1994

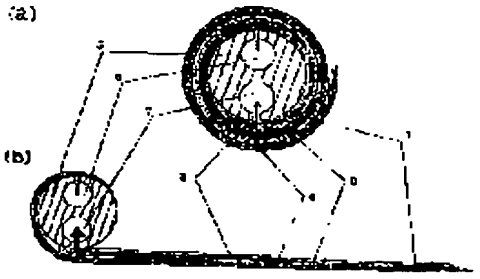
(51)Int.Cl. B01D 53/22
B01D 63/10

(21)Application number : 05-050327
(22)Date of filing : 11.03.1993

(71)Applicant : MATSUSHITA ELECTRIC IND CO LTD
(72)Inventor : KIMURA MASANORI
SAWADA TASUKE
HATANAKA SHIGEKI
KOBAYASHI TAKAKI
SUGAFUJI MASAYA

(54) AIR SEPARATION MEMBRANE MODULE

(57)Abstract:
PURPOSE: To provide an air separation membrane module generating no lowering of capacity due to the pressure loss in a transmitted air passage and having high volumetric efficiency.
CONSTITUTION: A transmitted air passage material 3 is held between flat air separation membranes 2 partially constituted of an air impermeable membrane 4 and the air separation membranes 2 are spirally wound around an air supply and discharge pipe 5 having an air supply pipe 6 and an exhaust pipe 7 integrally provided thereto along with a raw material air passage material 1 and one winding start parts of the membranes 2 communicate with the raw material passage material 1 and the air supply pipe 6. The air separation membranes 2 are bonded to the air supply and discharge pipe 5 so that the transmitted air passage material and exhaust pipe 7 communicate each other and the winding end parts thereof form the air separation membranes 2 into a bag shape so as to airtightly close the transmitted air passage material 3 and both side end parts in the winding direction are sealed so as to airtightly separate a raw material air passage and a transmitted air passage and, in the process from winding end to winding start, the transmitted air passage material 3 is made successively thick.



LEGAL STATUS

[Date of request for examination] 14.02.2000
[Date of sending the examiner's decision of rejection] 05.03.2002
[Kind of final disposal of application other than the examiner's decision of rejection or

application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] Transparency gas passage material is inserted by flat film-like gas permeation membrane or the gas permeation membrane of the shape of a flat film by which the part was constituted from gas nontransparent film. The gas permeation membrane and the raw material gas passage material which sandwiched said transparency gas passage material are made into a lot in piles. Around air-supply-and-exhaust tubing with which the exhaust pipe which exhausts this feed pipe which supplies raw material air for a lot at least and transparency gas was united, in the shape of a spiral Winding, The feed pipe of raw material gas passage material and air-supply-and-exhaust tubing opens the first end of a volume for free passage. Said gas permeation membrane is pasted up on air-supply-and-exhaust tubing so that the exhaust pipe of transparency gas passage material and air-supply-and-exhaust tubing may be open for free passage. The end of a volume end makes said gas permeation membrane saccate so that transparency gas passage may be closed airtightly. The both-sides edge of the winding direction is the gas-permeation-membrane module which is a gas-permeation-membrane module closed so that raw material gas passage and transparency gas passage might be separated airtightly, is the process in which it results from a volume end at the beginning of a volume, and thickened said transparency gas passage material one by one.
[Claim 2] Transparency gas passage material is inserted by flat film-like gas permeation membrane or the gas permeation membrane of the shape of a flat film by which the part was constituted from gas nontransparent film. Close the both-sides edge of said gas permeation membrane, and the gas permeation membrane and the raw material gas passage material which sandwiched said transparency gas passage material are made into a lot in piles. At least, around an exhaust pipe, in the shape of a spiral, said gas permeation membrane is pasted up on an exhaust pipe so that this exhaust pipe with which the winding and first end of a volume exhausts a lot, and transparency gas passage material may open a transparency gas for free passage. The end of a volume end is the gas-permeation-membrane module which is a gas-permeation-membrane module which made said gas permeation membrane saccate as transparency gas passage is closed airtightly, is the process in which it results from a volume end at the beginning of a volume, and thickened said transparency gas passage material one by one.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the spiral mold gas-permeation-membrane module which comes to wind the gas separation bipolar membrane of a flat film.
[0002]
[Description of the Prior Art] The gas-permeation-membrane module of the spiral mold which generally comes to wind a flat film sandwiches the transparency gas passage material which forms transparency gas passage by flat film-like gas permeation membrane, it pastes up gas permeation membrane on hollow tubing so that transparency gas passage may be open for free passage in the hole of hollow tubing which has a hole, with the raw material gas passage material which forms raw material gas passage, is wound around the surroundings of hollow tubing and constituted. Moreover, in Japanese Patent Application No. No. 249711 [four to], the artificer etc. pasted up gas permeation membrane on hollow tubing so that transparency gas passage material and raw material gas passage material might be open for free passage in the hole of hollow tubing which has two or more independent holes, respectively, and he proposed the gas-permeation-membrane module constituted by winding around hollow tubing.
[0003] A raw material gas is made into air about separation of the gas of the above-mentioned conventional gas-permeation-membrane module, and concentration, and the case where separate nitrogen and it condenses is explained using drawing.
[0004] Drawing 5 and drawing 6 are the examples of the gas-permeation-membrane module of the conventional spiral mold. Drawing 5 (a), The cross-section perspective view in which (b) developed the sectional view of the gas-permeation-membrane module of the conventional example 1, and the gas-permeation-membrane module, respectively, Drawing 6 (a), (b), and (c) are the sectional view of the gas-permeation-membrane module of the conventional example 2, the cross-section perspective view which developed the gas-permeation-membrane module, and the sectional view which developed the gas-permeation-membrane module in which gaseous flow is shown, respectively.
[0005] In drawing 5 , 22 is the gas separation bipolar membrane of the shape of a flat film of having formed gas permeation membrane on the porosity base material, and by return, a clinch part rolls it and, finally it has become so that the transparency gas passage material 23 may be inserted. Moreover, the both-sides edge of the winding direction (it is perpendicularly to hollow tubing) of the gas separation bipolar membrane 22 is closed with the sealing agent 25, and the gas separation bipolar membrane 22 has pasted up the first end of a volume on the hollow tubing 26 so that the transparency gas passage material 23 and the hollow tubing 26 may be open for free passage. Raw material gas passage is released.
[0006] In the above-mentioned configuration, if raw material air is supplied to the raw material gas passage which consisted of raw material gas passage material 21 in the direction of an arrow head (continuous line), raw material air flows the front-face top of the gas separation bipolar

membrane 22 which penetrates oxygen preferentially. Then, oxygen flows and goes the transparency gas passage which penetrated the gas separation bipolar membrane 22 preferentially, and consisted of transparency gas passage material 23 in the direction of an arrow head (broken line), and is discharged from the hollow tubing 26. Therefore, it will pass through a gas separation bipolar membrane top, and, as for the air which came out from the gas-permeation-membrane module, nitrogen will be condensed.

[0007] Drawing 6 sandwiches the transparency gas passage material 23 by flat film-like the gas separation bipolar membrane 22 and the gas nontransparent film 24. Moreover, with the raw material gas passage material 21 By the gas-permeation-membrane module of the spiral mold wound around the surroundings of the air-supply-and-exhaust tubing 27 which has the independent feed pipe 28 and an exhaust pipe 29 The gas separation bipolar membrane 22 and the gas nontransparent film 24 are pasted up on the air-supply-and-exhaust tubing 27 so that a feed pipe 28, the raw material gas passage material 21, and an exhaust pipe 29 and the transparency gas passage material 23 may be open for free passage, respectively, and it has closed so that raw material gas passage and transparency gas passage may be further separated for the both-sides edge of the winding direction airtightly.

[0008] If raw material air is supplied from the feed pipe 28 of this spiral mold gas-permeation-membrane module, the front-face top of the gas separation bipolar membrane 22 is flowed in the direction of an arrow head (continuous line) in a raw material gas feeder current way, and nitrogen can be condensed by preferential transparency of oxygen like the gas-permeation-membrane module of the conventional example 1. By this gas-permeation-membrane module, when raw material air flows in the winding direction, distance in which raw material air flows a gas separation bipolar membrane front-face top can be lengthened, and a gas-permeation-membrane module with high concentration effectiveness is obtained.

[0009]

[Problem(s) to be Solved by the Invention] However, the thickness of the transparency gas passage material 23 of the above-mentioned conventional gas-permeation-membrane module becomes fixed [the cross section of the passage where a gas flows in the process in which it results at the beginning of a volume, from a volume end since it is fixed] anyway. On the other hand, as the flow rate of the transparency gas which flows the inside of the transparency gas passage material 23 is shown in drawing 6 (c), it is the process of gas separation bipolar membrane in which wind and it results [from the end] in a cut water, and sequential addition will be carried out, it will increase, and the transparency gas of the amount penetrated all over gas-permeation-membrane 22 will pass in an exhaust pipe 27 and a part open for free passage. It is proportional to increase of a flow rate, and flow resistance also increases, and when the thickness of transparency gas passage material is not enough, flow resistance becomes large, pressure loss is produced, predetermined differential pressure is no longer obtained through gas permeation membrane, and it becomes impossible that is, to secure sufficient engine performance in the transparency gas passage material of fixed thickness (the cross section of passage is fixed).

[0010] Moreover, it sets among transparency gas passage into the exhaust pipe with which a transparency gas flow rate increases most, and a part open for free passage. When the thickness of transparency gas passage material is determined that pressure loss will become small enough, Beyond the need, transparency gas passage material will become thick, the appearance of the wound gas-permeation-membrane module becomes large as it results [from an exhaust pipe] in a volume end part, since the thickness of transparency gas passage material is fixed, and the volumetric efficiency over the engine performance of a gas-permeation-membrane module will fall.

[0011] Since the method which carries out pressurization supply of the raw material gas is generally taken in the gas-permeation-membrane module of a spiral mold, the volume of a supply

gas drops to several [under atmospheric pressure / 1/]. since [on the other hand,] a transparency gas serves as atmospheric pressure -- the flow rate of a transparency gas -- several times of a supply gas -- becoming -- the thickness of transparency gas passage material -- several times of raw material gas passage material -- being needed . Therefore, the rate of a volume ratio which the transparency gas passage material in a gas-permeation-membrane module occupies becomes high, and it becomes the important technical problem of improvement in volumetric efficiency, i.e., the improvement in the engine performance, and a miniaturization how transparency gas passage material can be made thin.

[0012] This invention solves the above-mentioned conventional technical problem, and it aims at offering the gas-permeation-membrane module which was excellent in concentration effectiveness and volumetric efficiency.

[0013]

[Means for Solving the Problem] In order to attain this purpose the gas-permeation-membrane module of this invention Transparency gas passage material is inserted by flat film-like gas permeation membrane or the gas permeation membrane of the shape of a flat film by which the part was constituted from gas nontransparent film. The gas permeation membrane and the raw material gas passage material which sandwiched the above-mentioned transparency gas passage material are made into a lot in piles. Around air-supply-and-exhaust tubing with which the exhaust pipe which exhausts this feed pipe which supplies raw material air for a lot at least and transparency gas was united, in the shape of a spiral Winding, The above-mentioned gas permeation membrane is pasted up on air-supply-and-exhaust tubing so that the feed pipe of raw material gas passage material and air-supply-and-exhaust tubing may open the first end of a volume for free passage and the exhaust pipe of transparency gas passage material and air-supply-and-exhaust tubing may be open for free passage. The end of a volume end makes the above-mentioned gas permeation membrane saccate so that transparency gas passage may be closed airtightly. The both-sides edge of the winding direction is the gas-permeation-membrane module closed so that raw material gas passage and transparency gas passage might be separated airtightly, is the process in which it results from a volume end at the beginning of a volume, and has the configuration which thickened the above-mentioned transparency gas passage material one by one.

[0014] Moreover, transparency gas passage material is inserted by flat film-like gas permeation membrane or the gas permeation membrane of the shape of a flat film by which the part was constituted from gas nontransparent film. Close the both-sides edge of this gas permeation membrane, and the gas permeation membrane and the raw material gas passage material which sandwiched the above-mentioned transparency gas passage material are made into a lot in piles. At least, the above-mentioned gas permeation membrane is pasted up on an exhaust pipe so that, as for the winding and first end of a volume, this exhaust pipe that exhausts a transparency gas, and transparency gas passage material may open a lot for free passage in the shape of a spiral around an exhaust pipe. The end of a volume end is the gas-permeation-membrane module which made the above-mentioned gas permeation membrane saccate, as transparency gas passage is closed airtightly, it is the process in which it results from a volume end at the beginning of a volume, and has the configuration which thickened the above-mentioned transparency gas passage material one by one.

[0015]

[Function] The gas-permeation-membrane module with high volumetric efficiency which can reduce the high transparency gas passage material of the rate of a volume ratio in a gas-permeation-membrane module, and does not have the degradation by pressure loss since transparency gas passage material becomes thick one by one and passage becomes large in connection with it even if the flow rate of a transparency gas carries out sequential increase in the process in which it moreover results [from a volume end] in a cut water is realizable with

this configuration.
[0016]
[Example]
(Example 1) One example of this invention is explained below, referring to a drawing. The sectional view where, as for drawing 1 (a), the sectional view of the gas-permeation-membrane module of this example, drawing 1 (b), and drawing 2 developed the gas-permeation-membrane module, and drawing 3 are the examples of use of this example.
[0017] In drawing 1 , 1 is raw material gas passage material, and has used one polyethylene shaping network with a thickness of 0.4mm of 15 meshes. 2 is gas separation bipolar membrane, it is the unsymmetrical structure which carried out the laminating of the gas permeation membrane of the Pori 4 methyl pentene 1 on the porosity base material, and carried out the laminating of the poly dimethylsiloxane on it further, and it is allotted so that a demarcation membrane side may face the raw material gas passage material 1.
[0018] 3 -- transparency gas passage material -- it is -- the polyethylene shaping network with a thickness of 0.4mm of 15 meshes -- 100cm from the end of a volume -- until -- it is one sheet, and after it, every 50cm, it increases one sheet at a time, a laminating is carried out, and it is constituted. 4 is polyester film with a thickness of 100 micrometers by the gas nontransparent film. As for 5, the feed pipe 6 and the exhaust pipe 7 are arranged independently in the die-length direction in parallel with air-supply-and-exhaust tubing, and the exterior and a hole open for free passage have opened in the feed pipe 6 and the exhaust pipe 7, respectively.
[0019] So that the above-mentioned raw material gas passage material 1 may be open for free passage to a feed pipe 6 and the transparency gas passage material 3 may be open for free passage to an exhaust pipe 7 The gas separation bipolar membrane 2 and the gas nontransparent film 4 are airtightly pasted up on the air-supply-and-exhaust tubing 5. After winding the ingredient of the gas nontransparent film 4 around the surroundings of the air-supply-and-exhaust tubing 5 in the shape of a spiral from the raw material gas passage material 1, The gas separation bipolar membrane 2 and the gas nontransparent film 4 are airtightly pasted up by the end in the volume end of the gas separation bipolar membrane 2, and like drawing 3 , with a sealing agent 8, adhesion closure of other 2 sides is carried out so that raw material gas passage and transparency gas passage may be separated airtightly.
[0020] As compared with the gas-permeation-membrane module which the gas-permeation-membrane module constituted as mentioned above made only transparency gas passage material fixed thickness, and was created similarly, the amount of the transparency gas passage material used became half mostly, and the outer diameter of a gas-permeation-membrane module became small 30mm.
[0021] Moreover, nitrogen concentration was 97.5% when the nitrogen concentration air flow rate which contains the above-mentioned gas-permeation-membrane module in a pressurized container 9, supplies air 4.2x10-4m3/s (25 l/min) pressurized by 592Pa (5 kgf/cm2G) from the feed pipe 6, and is obtained from a flow control valve 10 was adjusted at 8.3x10-5m3/s (5 l/min), as shown in drawing 3 .
[0022] According to this example, transparency gas passage material is inserted by the gas nontransparent film and flat film-like gas permeation membrane as mentioned above. The gas permeation membrane and the raw material gas passage material which sandwiched transparency gas passage material are made into a lot in piles. Around air-supply-and-exhaust tubing with which the feed pipe which supplies raw material air for a lot or two or more of these sets, and the exhaust pipe which exhausts a transparency gas were united, in the shape of a spiral Winding, The feed pipe of raw material gas passage material and air-supply-and-exhaust tubing opens the first end of a volume for free passage. The gas nontransparent film and gas permeation membrane are pasted up on air-supply-and-exhaust tubing so that the exhaust pipe of transparency gas passage material and air-supply-and-exhaust tubing may be open for free

passage. It is the process in which the end of a volume end pastes up nontransparent gas transparency material and gas permeation membrane on saccate so that transparency gas passage may be closed airtightly, close the both-sides edge of the winding direction so that raw material gas passage and transparency gas passage may be separated airtightly, and it results from a volume end at the beginning of a volume. By thickening transparency gas passage material one by one, a gas-permeation-membrane module with high volumetric efficiency is obtained.

[0023] In addition, comparatively, since [of the space per unit volume of a network] the optimal value is determined by the recovery (ratio of the nitrogen concentration air content over an air-supply air content) of the permeability ability of gas permeation membrane, the gas separation engine performance, and a gas-permeation-membrane module etc., the number of laminatings of the network which constitutes the transparency gas passage material 3 of the gas-permeation-membrane module of this example, and the die length of each network which is carrying out the laminating are not limited to the value of this example.

[0024] Moreover, although the laminating of the transparency gas passage material 3 of the gas-permeation-membrane module of this example was carried out and the polyethylene rennet was used for it, this is not limited especially if the nonwoven fabric using the foaming form using the network which used resin, such as polypropylene and a polyvinyl chloride, or urethane, polystyrene, etc., or polyester etc. is the shaping resin article which forms gaseous passage.

[0025] Furthermore, although considered as the configuration which carried out the laminating of the network of fixed thickness in this example, as shown in 3-1 of drawing 2 , it can be good also as a configuration which fabricated a network and the above-mentioned passage material in one so that thickness might change smoothly, volumetric efficiency can become good in this case, deformation of the gas permeation membrane by the level difference of a network can also be avoided, and a rolling-up man day can also be reduced.

[0026] (Example 2) The 2nd example of this invention is explained below, referring to drawing 4 .

[0027] Although 1 is the configuration same at raw material gas passage material as an example 1, winding lay length has dropped to 1/2. Although 2 is the same configuration as an example 1 in gas separation bipolar membrane, turn up so that the transparency gas passage material 3 may be inserted, and it is made for a clinch part to serve as a volume end, and it has closed the both-sides edge. Moreover, the gas nontransparent film 4 has pasted the clinch part of the gas separation bipolar membrane 2, and the gas nontransparent film 4 has covered the periphery of the gas separation bipolar membrane 2. From the end of a volume to 50cm is one sheet, and 3 is taken as the configuration which increased one sheet at a time and carried out the laminating every 25cm after it, although this is also the same configuration as an example 1 in transparency gas passage material.

[0028] The gas separation bipolar membrane 2 is airtightly pasted up on the air-supply-and-exhaust tubing 5, and the ingredient of the gas nontransparent film 4 is wound around the surroundings of the air-supply-and-exhaust tubing 5 in the shape of a spiral from the raw material gas passage material 1 so that the above-mentioned raw material gas passage material 1 may be open for free passage to a feed pipe 6 and the transparency gas passage material 3 may be open for free passage to an exhaust pipe 7. The outer diameter of this gas-permeation-membrane module became small 10mm compared with the gas-permeation-membrane module of an example 1.

[0029] Nitrogen concentration was 97.4% when the nitrogen concentration air flow rate which contains the gas-permeation-membrane module constituted as mentioned above in a pressurized container 9 as shown in drawing 3 , supplies air 4.2x10-4m33/s (25 l/min) pressurized by 592Pa (5 kgf/cm2G) from the feed pipe 6, and is obtained from a flow control valve 10 was adjusted at 8.3x10-5m3/s (5 l/min).

[0030] According to this example, transparency gas passage material is inserted as mentioned

above by the gas permeation membrane of the shape of a flat film by which the part was constituted from gas nontransparent film. The gas permeation membrane and the raw material gas passage material which sandwiched this transparency gas passage material are made into a lot in piles. Around air-supply-and-exhaust tubing with which the feed pipe which supplies raw material air for a lot or two or more of these sets, and the exhaust pipe which exhausts a transparency gas were united, in the shape of a spiral Winding, The feed pipe of raw material gas passage material and air-supply-and-exhaust tubing opens the first end of a volume for free passage. Gas permeation membrane is pasted up on air-supply-and-exhaust tubing so that the exhaust pipe of transparency gas passage material and air-supply-and-exhaust tubing may be open for free passage. It is the process in which make it the end of the volume end of gas permeation membrane serve as a clinch part of gas permeation membrane, close the both-sides edge of the winding direction so that raw material gas passage and transparency gas passage may be separated airtightly, and it results from a volume end at the beginning of a volume. By thickening transparency gas passage material one by one, transparency gas passage material can be reduced further and volumetric efficiency can be improved more.

[0031]

[Effect of the Invention] According to this invention, transparency gas passage material as mentioned above Flat film-like gas permeation membrane, Or it inserts by the gas permeation membrane of the shape of a flat film by which the part was constituted from gas nontransparent film. The gas permeation membrane and the raw material gas passage material which sandwiched this transparency gas passage material are made into a lot in piles. Around air-supply-and-exhaust tubing with which the feed pipe which supplies raw material air for a lot or two or more of these sets, and the exhaust pipe which exhausts a transparency gas were united, in the shape of a spiral Winding, The feed pipe of raw material gas passage material and air-supply-and-exhaust tubing opens the first end of a volume for free passage. Gas permeation membrane is pasted up on air-supply-and-exhaust tubing so that the exhaust pipe of transparency gas passage material and air-supply-and-exhaust tubing may be open for free passage. It is the process in which the end of a volume end makes gas permeation membrane saccate so that transparency gas passage may be closed airtightly, close the both-sides edge of the winding direction so that raw material gas passage and transparency gas passage may be separated airtightly, and it results from a volume end at the beginning of a volume. The configuration which thickened said transparency gas passage material one by one, or flat film-like gas permeation membrane, Or transparency gas passage material is inserted by the gas permeation membrane of the shape of a flat film by which the part was constituted from gas nontransparent film. Close the both-sides edge of gas permeation membrane, and the gas permeation membrane and the raw material gas passage material which sandwiched transparency gas passage material are made into a lot in piles. A lot or two or more of these sets in the shape of a spiral around an exhaust pipe Winding, It is the process in which the first end of a volume pastes up gas permeation membrane on an exhaust pipe so that the exhaust pipe and transparency gas passage material which exhaust a transparency gas may be open for free passage, the end of a volume end makes gas permeation membrane saccate so that transparency gas passage may be closed airtightly, and it results from a volume end at the beginning of a volume. Since passage material becomes thick one by one and passage becomes large in connection with it, even if the flow rate of a transparency gas carries out sequential increase in the process in which it results [from a volume end] in a cut water by considering as the configuration which thickened transparency gas passage material one by one, A gas-permeation-membrane module with volumetric efficiency high moreover without the degradation by pressure loss is realizable.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The (a) sectional view and (b) expansion sectional view of a gas-permeation-membrane module of an example 1
[Drawing 2] The sectional view which developed other gas-permeation-membrane modules of an example 1
[Drawing 3] The sectional view showing the example of use of the gas-permeation-membrane module of examples 1 and 2
[Drawing 4] The sectional view of the gas-permeation-membrane module of an example 2
[Drawing 5] the (a) sectional view of the gas-permeation-membrane module of the conventional example 1, and (b) -- a part -- an expansion perspective view
[Drawing 6] the (a) sectional view of the gas-permeation-membrane module of the conventional example 2, and (b) -- a part -- an expansion perspective view and (c) expansion sectional view
[Description of Notations]
1 Raw Material Gas Passage Material
2 Gas Separation Bipolar Membrane
3 Transparency Gas Passage Material
4 Gas Nontransparent Film
5 Air-Supply-and-Exhaust Tubing
6 Feed Pipe
7 Exhaust Pipe
8 Sealing Agent

[Translation done.]